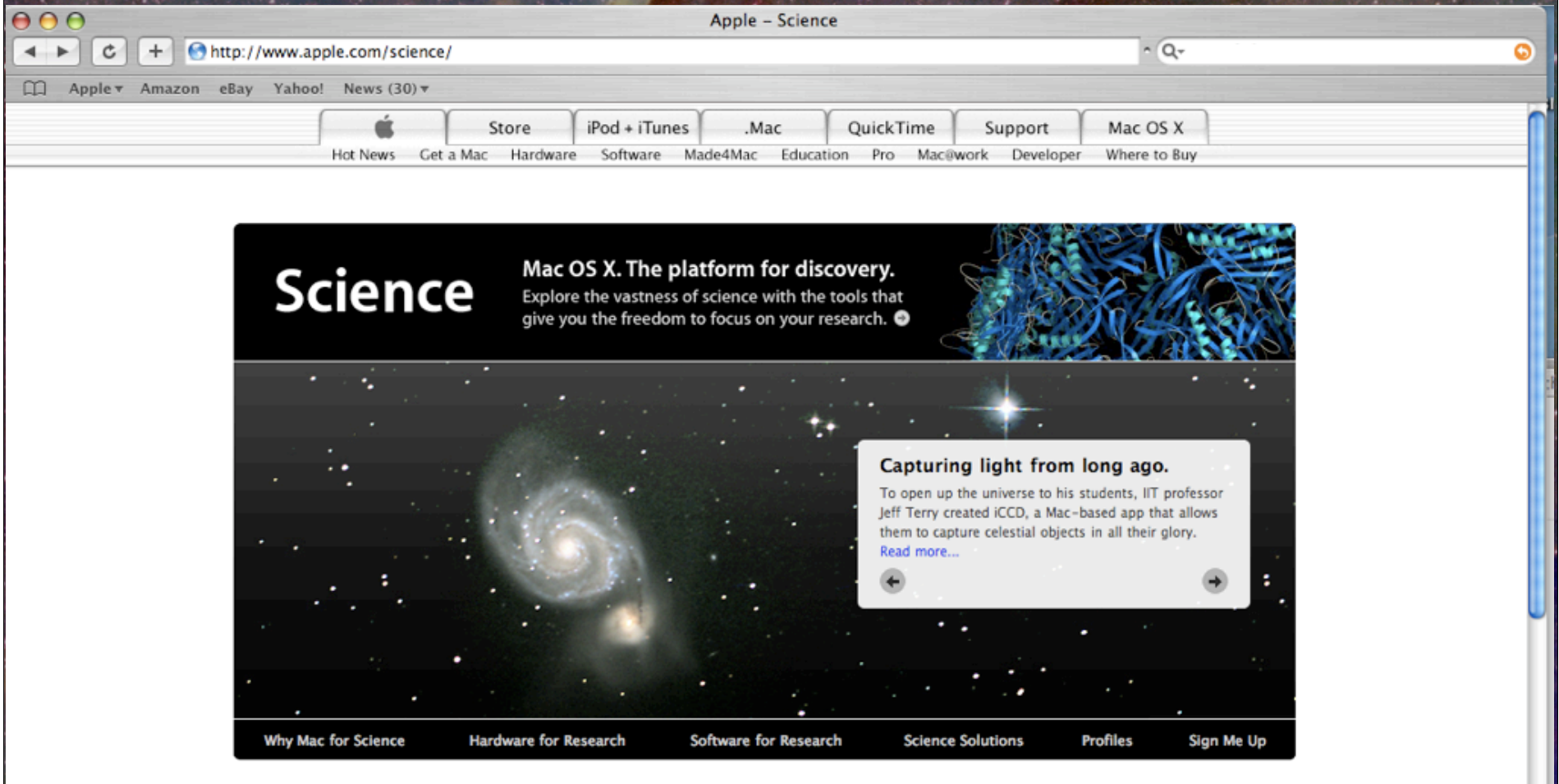




iCCD For Image Processing And Image Collection

Jeff Terry
Midwest Astroimaging Conference
July 14, 2007

Why Am I Here?



Why Macs?



Apache Point 3.5 m



> 3.5 m Run With All Macs. Sloan Moving That Way

Engineers Dig The BSOD

A problem has been detected and windows has been shut down to prevent damage to your computer.

The problem seems to be caused by the following file: SPCMDCON.SYS

PAGE_FAULT_IN_NONPAGED_AREA

If this is the first time you've seen this stop error screen, restart your computer. If this screen appears again, follow these steps:

Check to make sure any new hardware or software is properly installed. If this is a new installation, ask your hardware or software manufacturer for any windows updates you might need.

If problems continue, disable or remove any newly installed hardware or software. Disable BIOS memory options such as caching or shadowing. If you need to use Safe Mode to remove or disable components, restart your computer, press F8 to select Advanced Startup options, and then select Safe Mode.

Technical information:

*** STOP: 0x00000050 (0xFD3094C2,0x00000001,0xFBFE7617,0x00000000)

*** SPCMDCON.SYS - Address FBFE7617 base at FBFE5000, DateStamp 3d6dd67c

> Not Scientists

Telescope

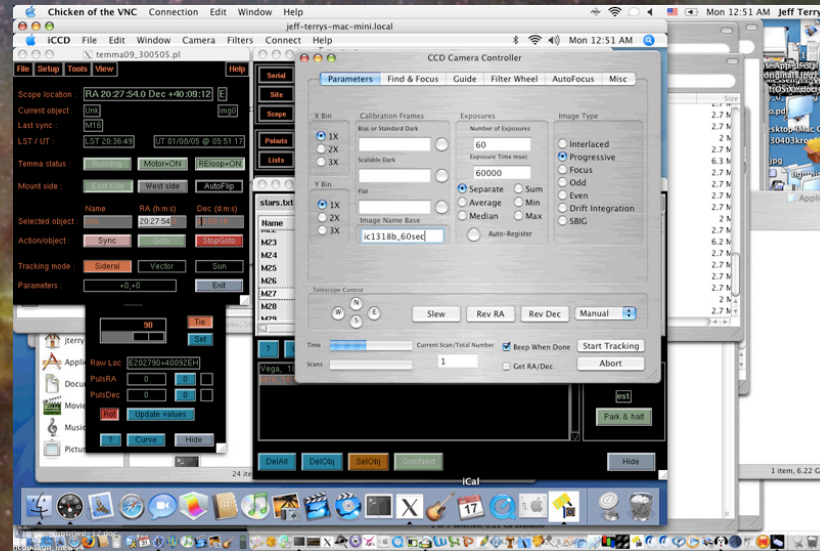


> IPRO Course

Telescopes



Mac Mini Controlled Remotely
Across A Wireless Network



> Mac mini fits perfectly on the tripod tray

Why iCCD?

- > Minimalist Interface
- > Simplified Feature Set
- > Powerful Processing Routines
- > FITS Viewer
- > Camera Control
- > Pretty Cheap, Too

Starlight Express

> MX7C

> MX7

> SXV-MX7

> SXV-MX7C

> SXV-H9

> SXV-H9C

> SXV-M8C

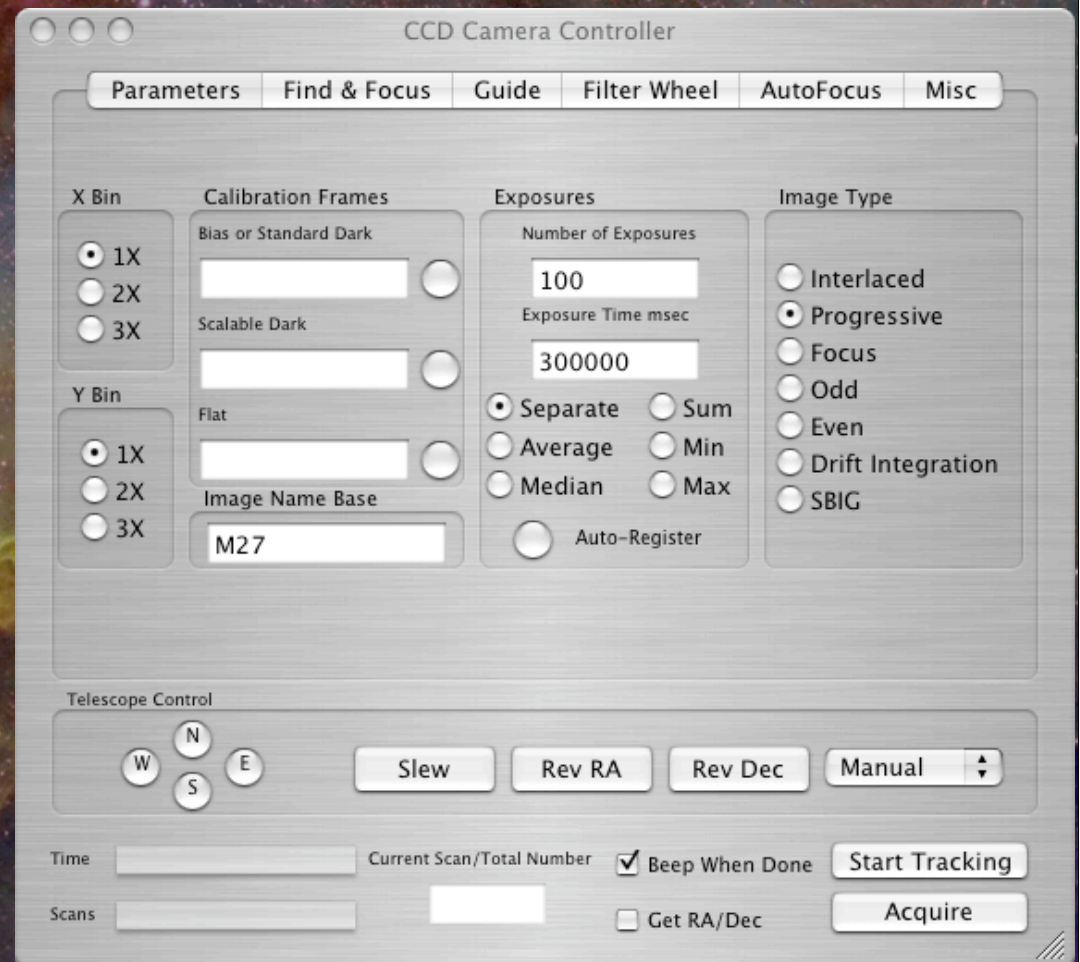
> <http://www.astrovid.com>

> <http://www.starlight-xpress.co.uk>



Collection

- > CCD Camera Controller
- > Camera:Open Control Window Menu Item



Collection

- > Image Name
 - > Autosave - M27_001.SX
- > Number of Images
- > Exposure Time
 - > Milliseconds Best Exposure Control
 - > 300000 msec = 5 minutes
- > Binning
- > Image Type
 - > Progressive
 - > Interlaced
 - > Focus
- > Acquire

The screenshot shows the 'CCD Camera Controller' software window. It has a menu bar with 'Parameters', 'Find & Focus', 'Guide', 'Filter Wheel', 'AutoFocus', and 'Misc'. The 'Parameters' tab is active, showing settings for X Bin (1X selected), Y Bin (1X selected), Calibration Frames (Bias or Standard Dark, Scalable Dark, Flat), Exposures (Number of Exposures: 100, Exposure Time msec: 300000, Separate selected, Average, Median, Auto-Register), and Image Type (Progressive selected, Focus, Odd, Even, Drift Integration, SBIG). The 'Telescope Control' section includes a directional pad (N, S, E, W), 'Slew', 'Rev RA', 'Rev Dec', and 'Manual' buttons. At the bottom, there are fields for 'Time', 'Current Scan/Total Number', 'Beep When Done' (checked), 'Start Tracking', 'Scans', 'Get RA/Dec' (unchecked), and 'Acquire'.

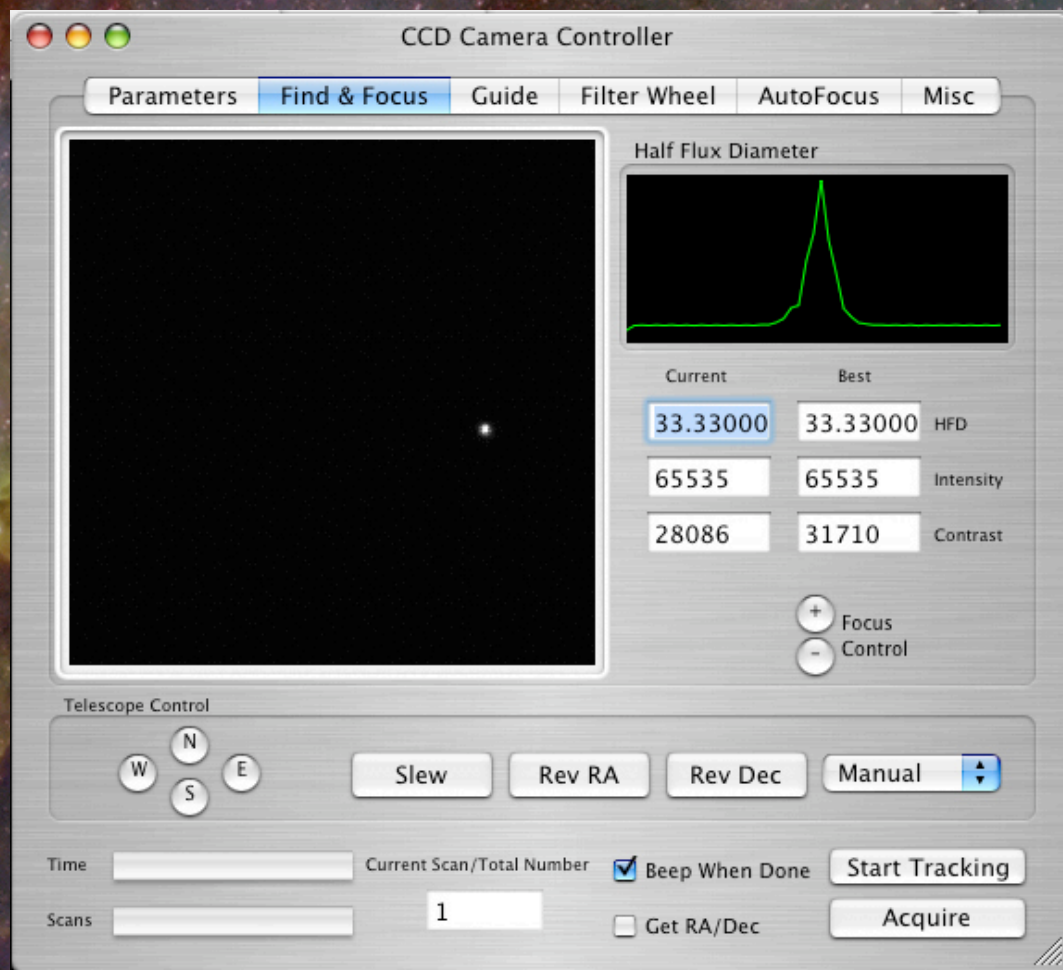
Focusing

> Collect an Image

- > Pick Bright Star
- > Not Saturated
- > Set Time < 5 sec
- > Click On Star to Select

> Select Focus Image Type

- > Parameters Screen
- > Acquire



Focusing

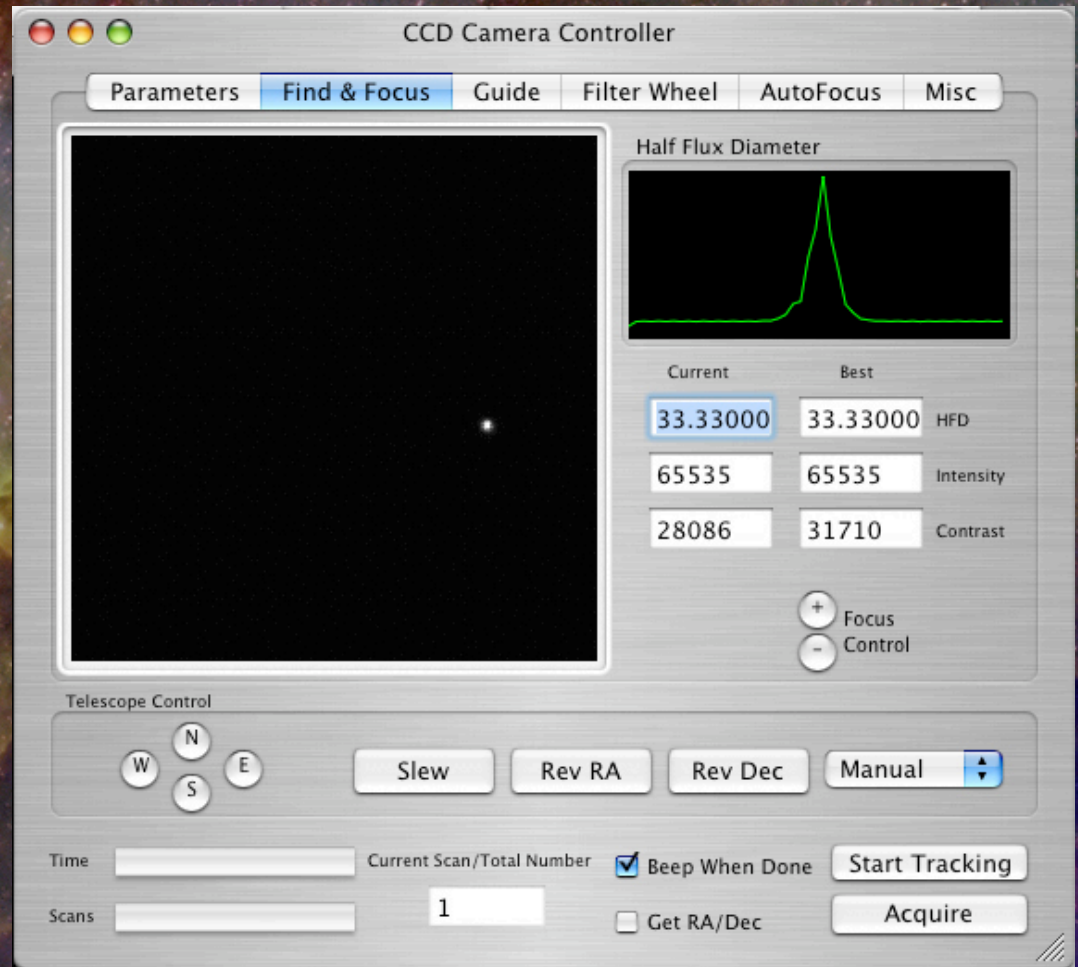
> Optimize

- > Pick Bright Star
- > Not Saturated
- > Set Time < 5 sec
- > Click On Star to Select

> Select Focus Image Type

- > Minimize HFD
- > Maximize Intensity
- > Maximize Contrast
- > Exception Minimize For
- > High Magnification Lunar/Planetary
- > Daytime Images

> Abort When Finished



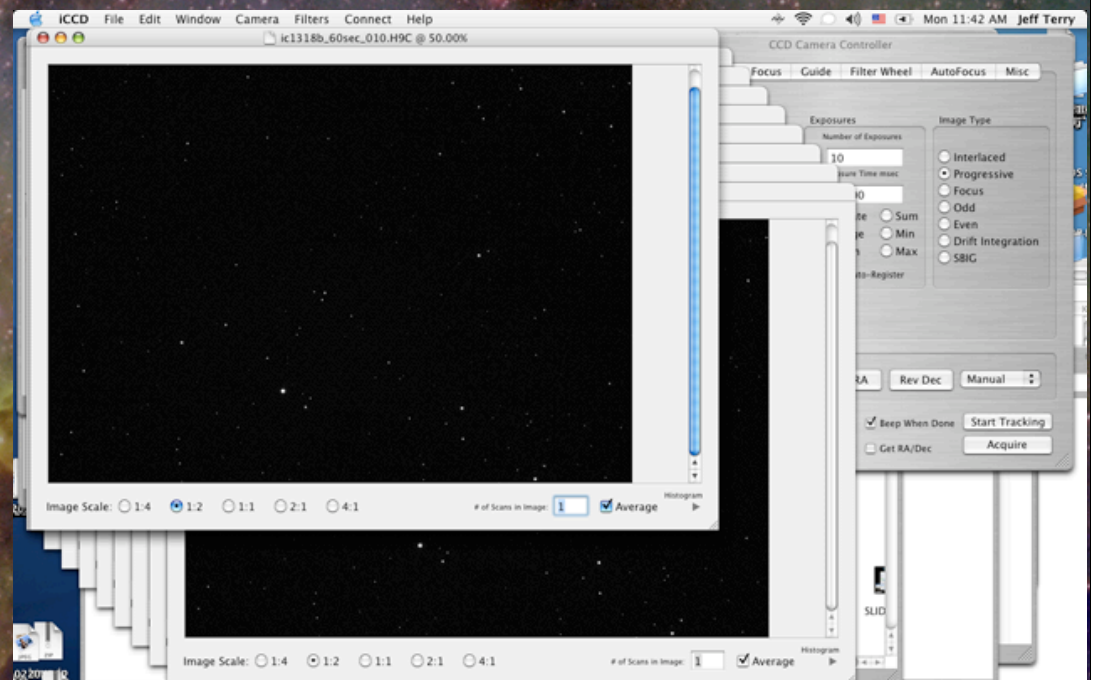
Focus Progression



- Focusing Is Crucial To Obtaining The Best Images
- Image Resolution Is Lost When Imaging At An Incorrect Focus Position

Acquire

- > After Focusing
- > Select Image Type
 - > Interlaced
 - > Progressive
- > Acquire
- > Check Focus Every 15 - 30 Minutes Depending Upon Temperature



Color Imaging

- iCCD Automatically Color Converts Your Raw Images If You Are Using A Color Camera

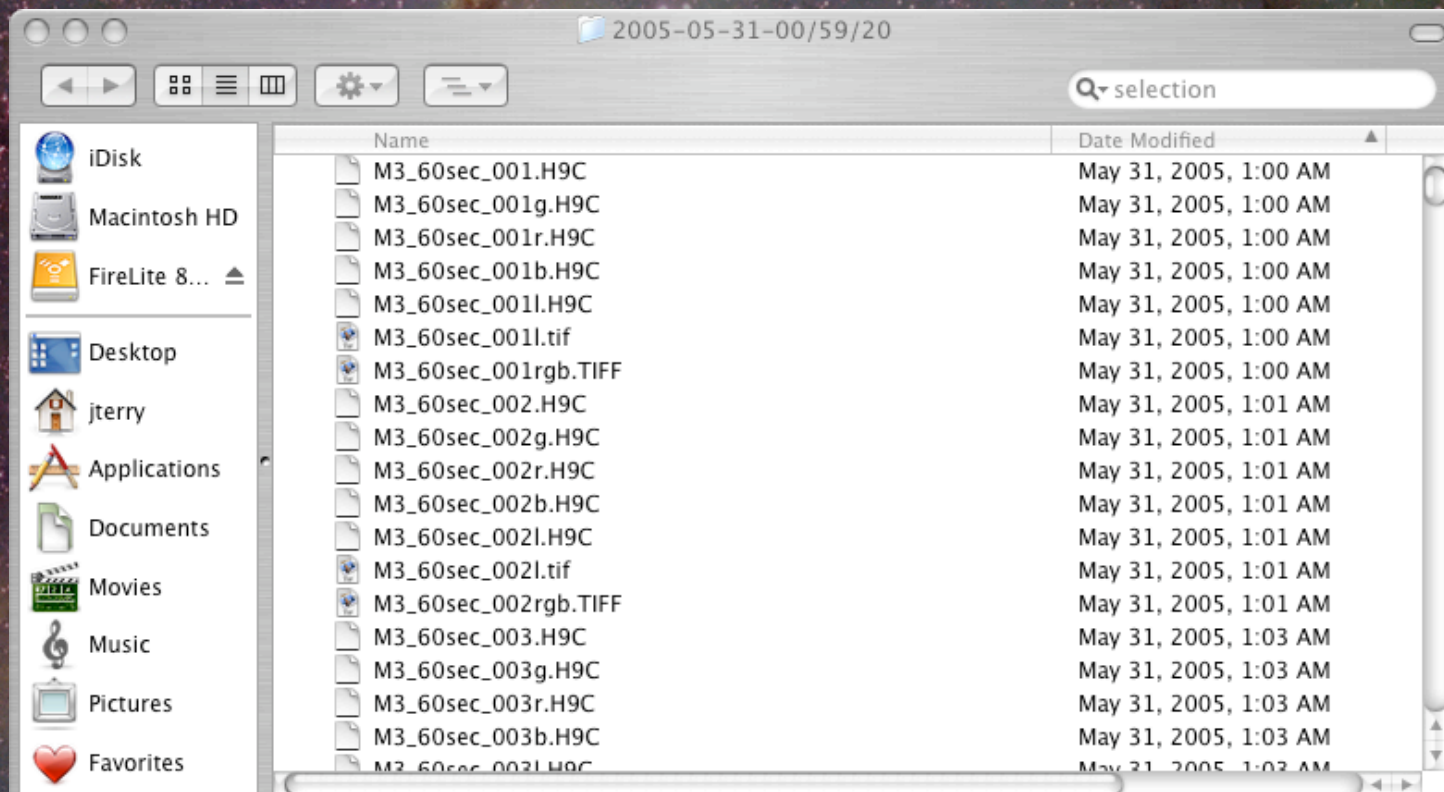


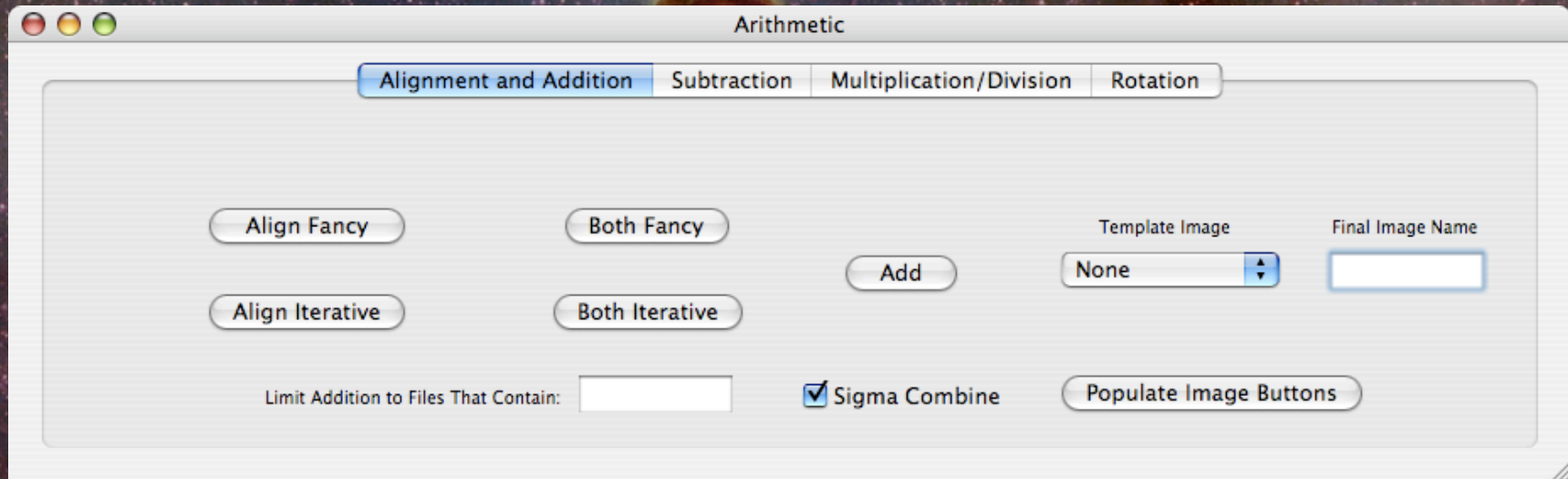
Image Calibration

- Bias Frames
- Bias Frames Subtracted
- Dark Frames
- Dark Frames Subtracted
- Light Frames
- Light Frames Divided

Image Calibration

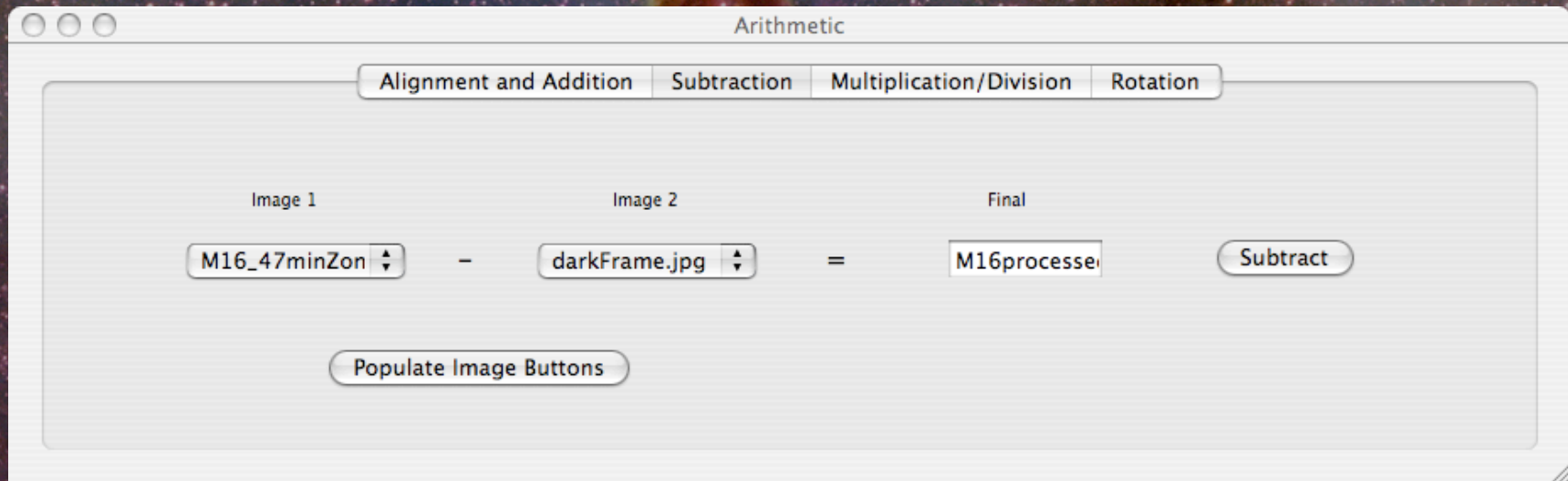
- > iCCD Provides Arithmetic Routines For Handling Dark, Light, and Bias Frames
- > Processing These Calibration Frames Always Adds Noise To An Image
- > 90% Of The Time Bias and Dark Corrections are Unnecessary For The SX Cameras
- > Light Frames Are Only Needed To Correct For Vignetting Or Dust Particles

Arithmetic



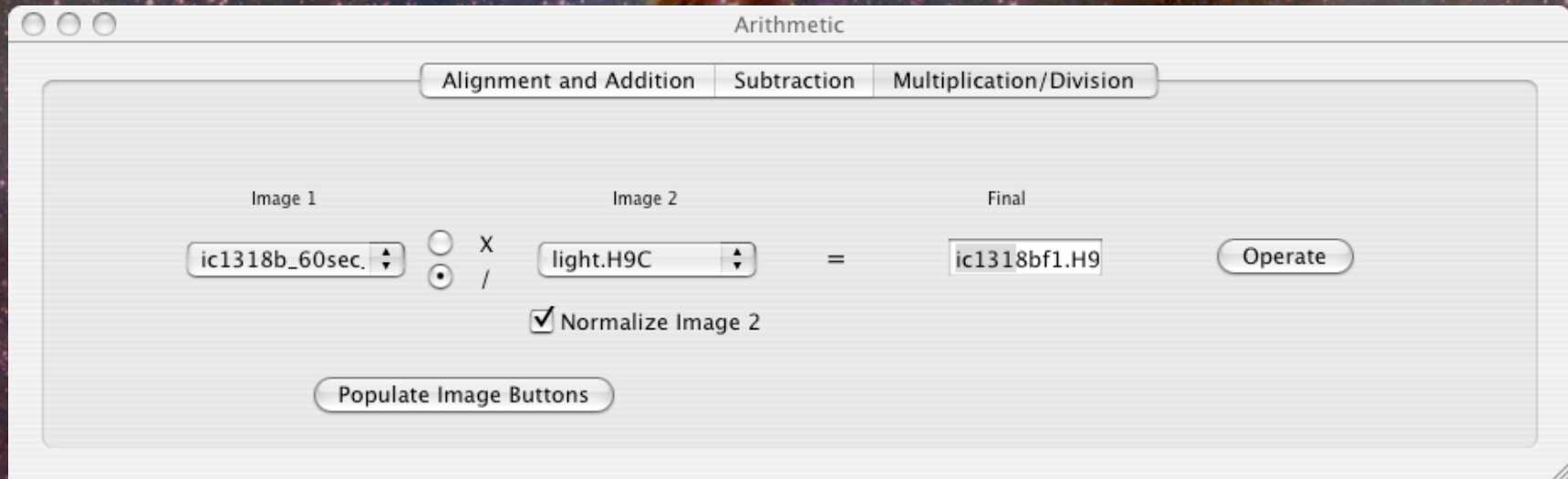
- Filters: Arithmetic Menu Item
- Four Tabs
 - Alignment and Addition
 - Subtraction
 - Multiplication/Division
 - Rotation

Subtraction



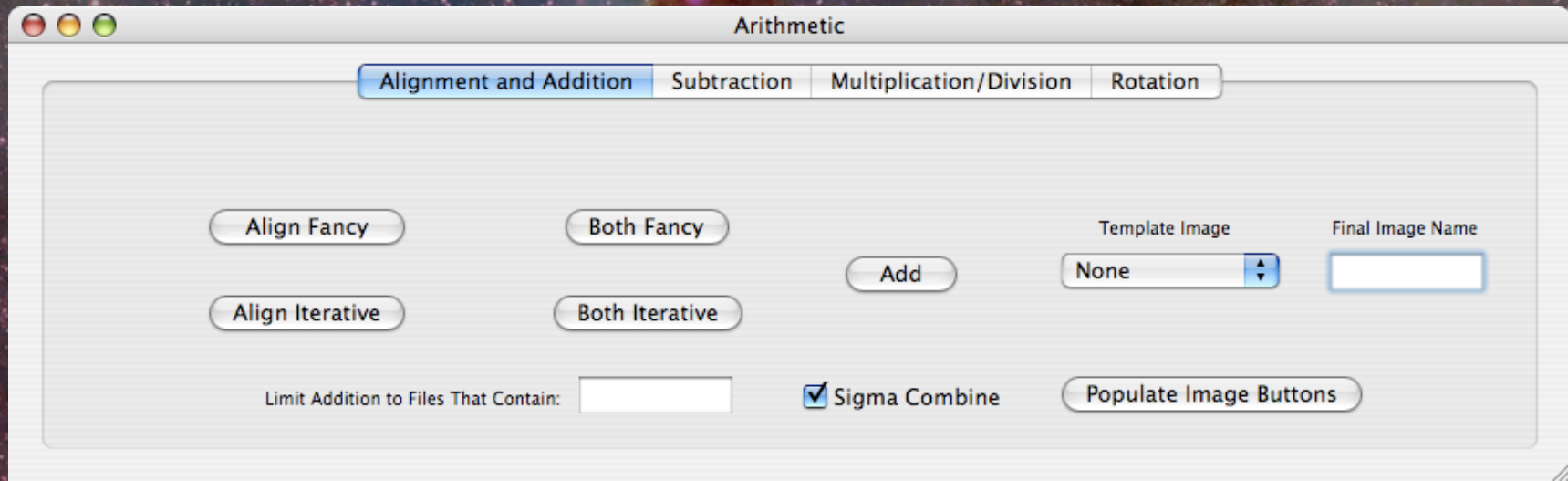
- > Hit Populate Image Buttons
- > Select Two Images To Subtract
- > Bias Frames 1 msec
- > Dark Frames Equal To Exposure Time

Multiplication / Division



- > Hit Populate Image Buttons
- > Select Two Images
- > Select Operator and Normalization
- > Light Frames Equal To ~ 30000 ADU

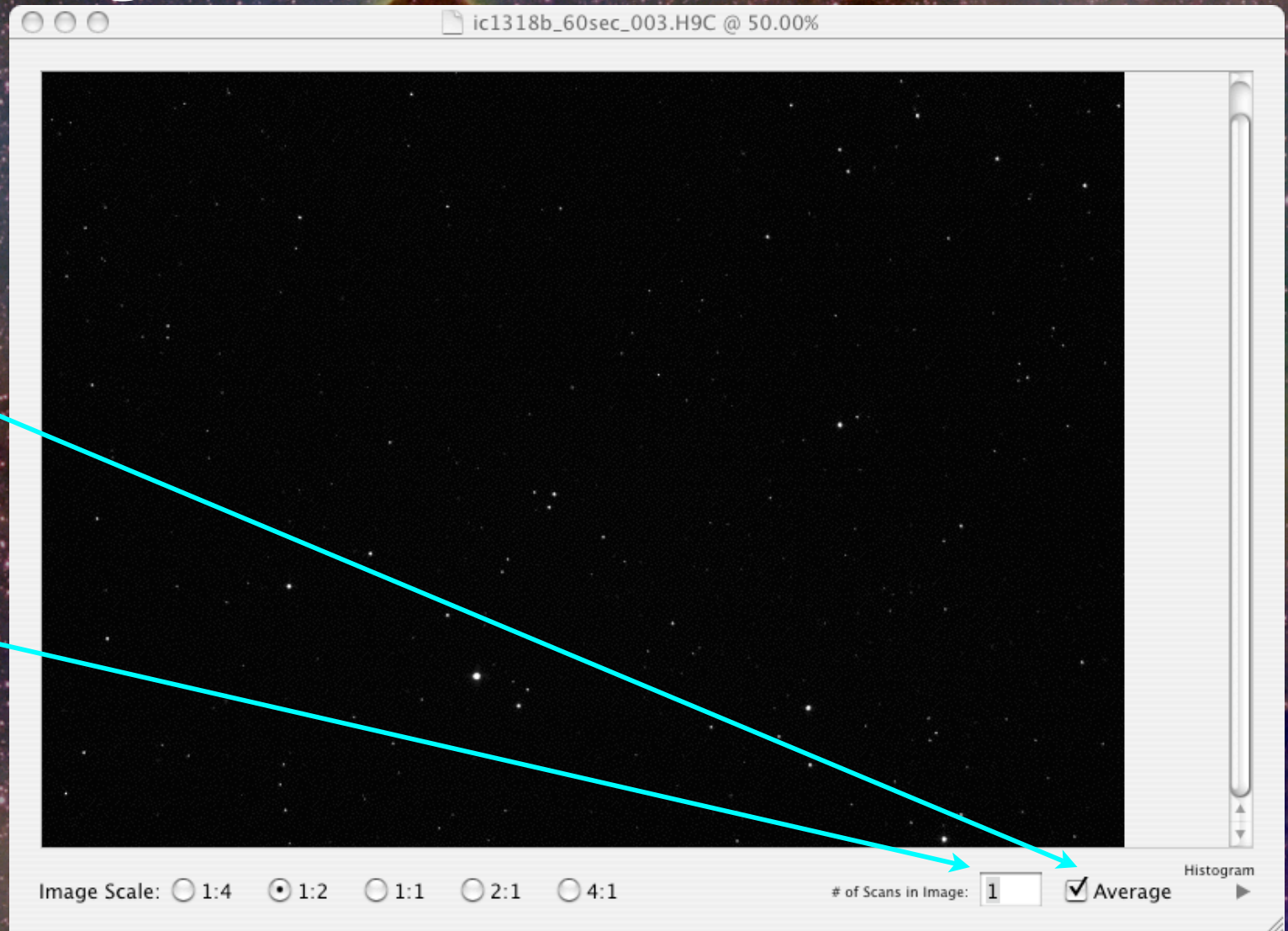
Alignment / Addition



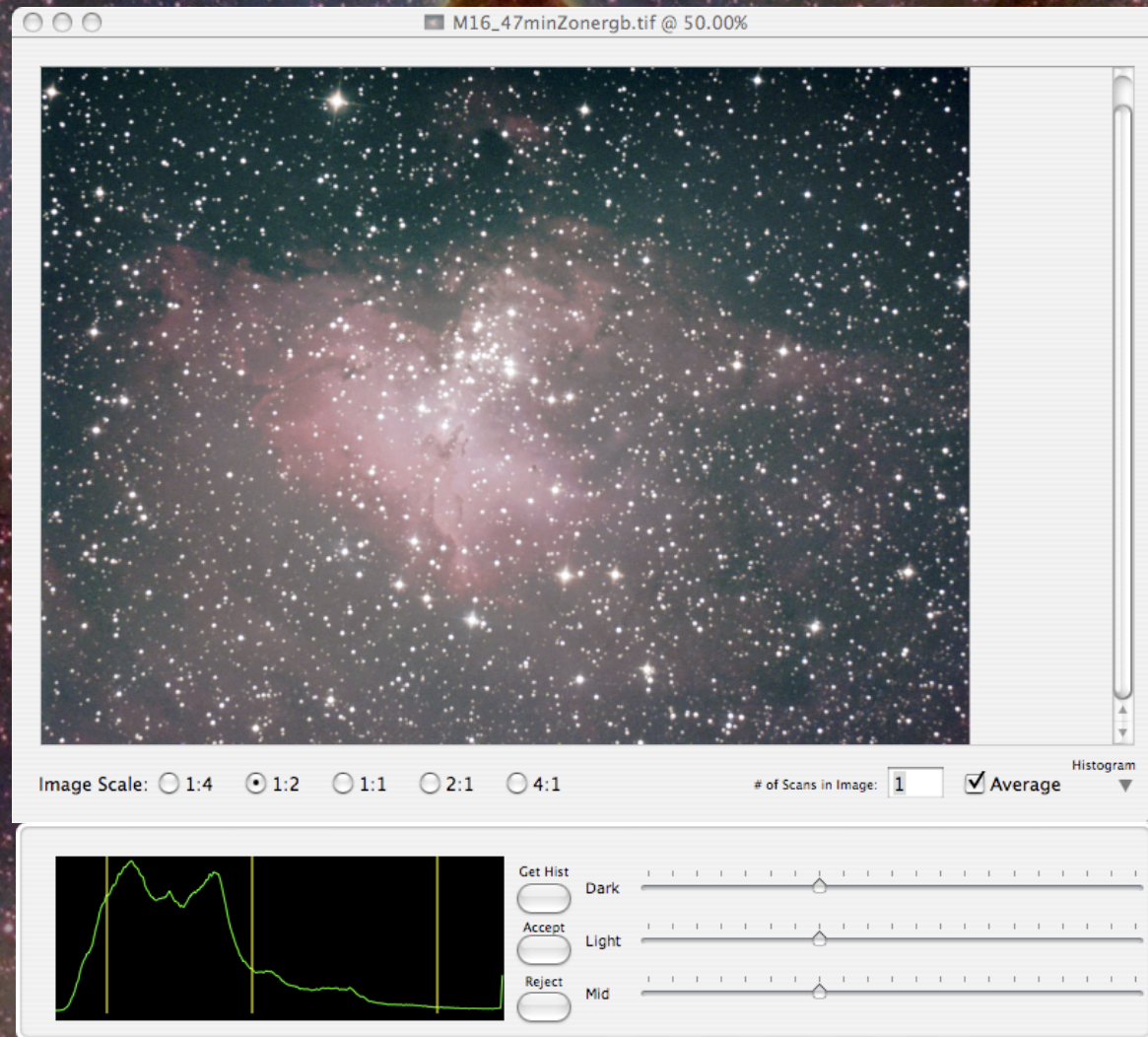
- > Finally, happy with an image alignment procedure
- > Addition
 - > Average or Sigma Combine

Alignment / Addition

- > Addition
- > Include in Average Box
- > Equivalent Scans in Image



Histogram

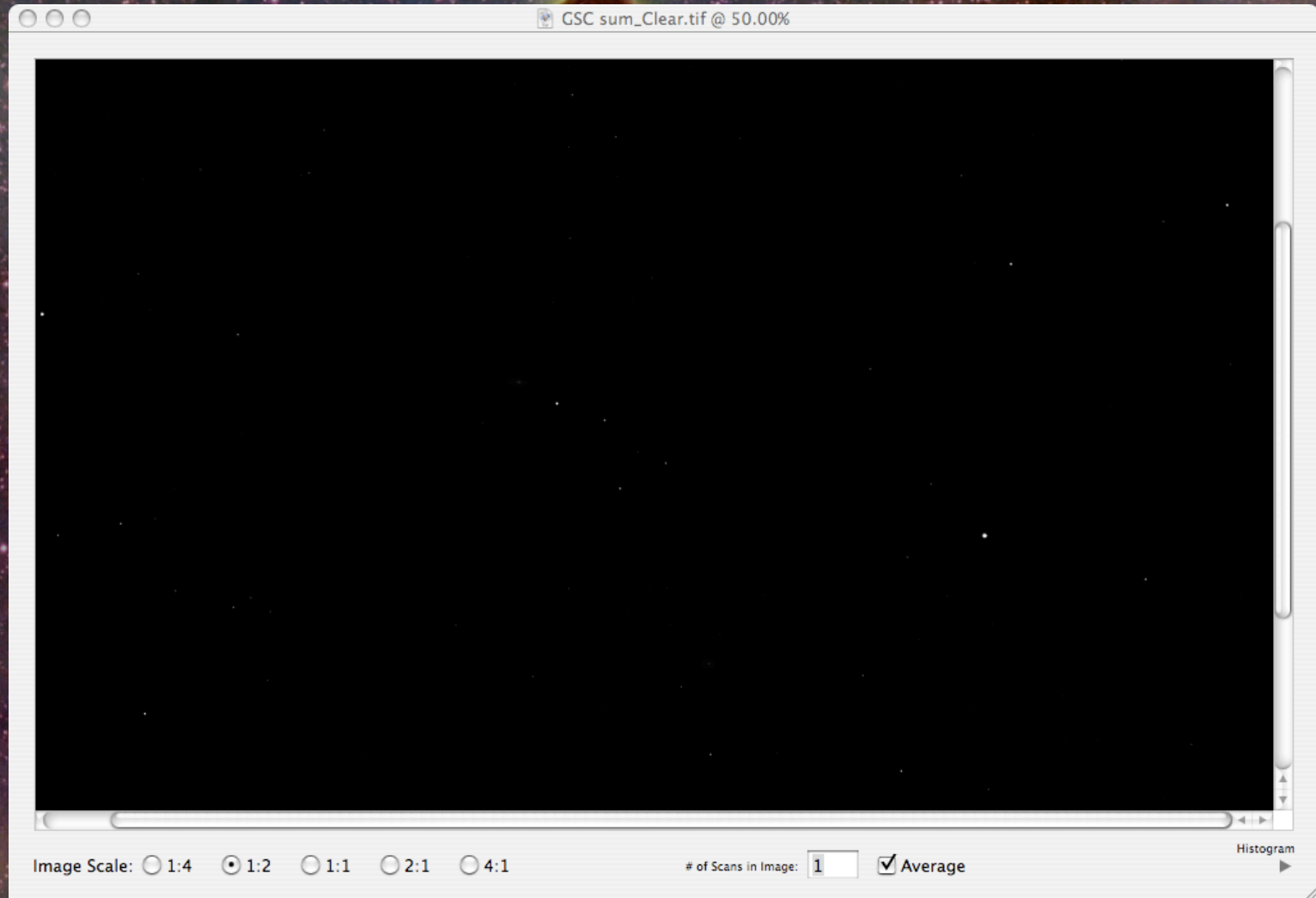


> Histogram Allows For Level Adjustment

Filters

- > Digital Development
- > Filters:Digital Filters:Digital Development
- > Filters:Digital Filters:DDP No Sharpen
- > Automatic Level Adjustment

DDP



> DDP Image Brings Out Regions of Lower Intensity

DDP



> DDP Image Brings Out Regions of Lower Intensity

Hot Pixel Killer

- > The Hot Pixel Killer
 - > Filters:Digital Filters:Hot Pixel Killer
 - > Removes Hot Pixels From A Single Frame
 - > Recommended on Color Frames From Color Cameras

Deconvolution

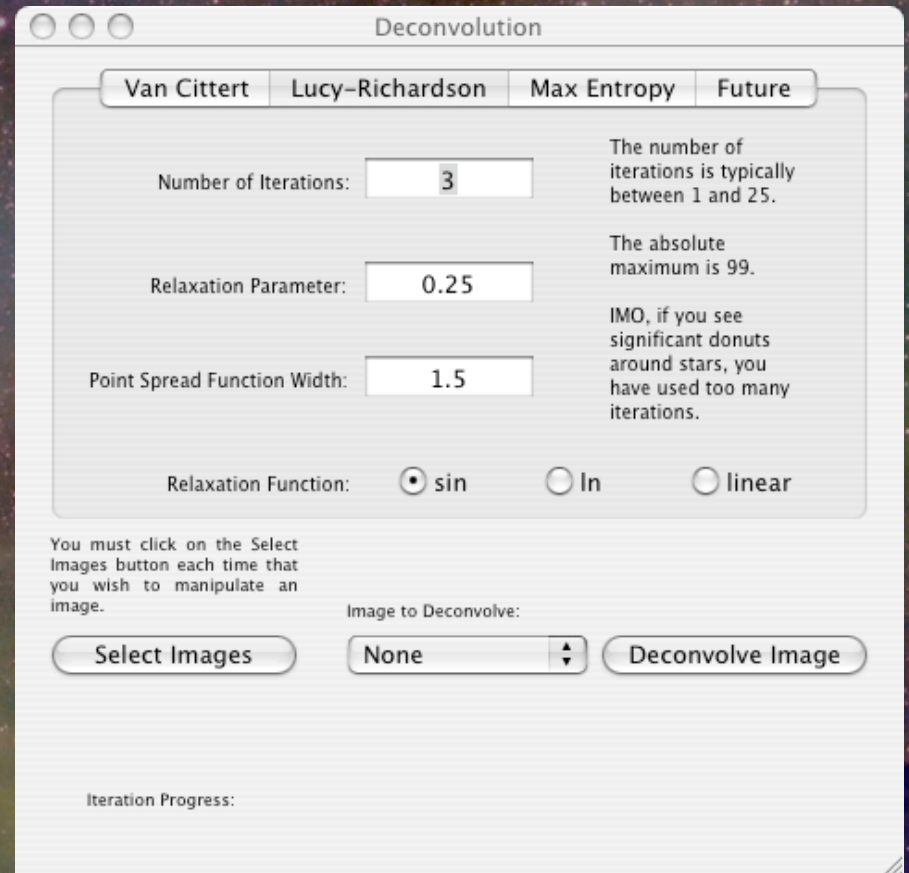
- Should Only Be Used On Luminance Frames
- Do Not Deconvolve Color Frames
- Less Is More
- Deconvolution Adds Significant Noise Per Iteration

Deconvolution

- > Lucy-Richardson
 - > Better on Deep Sky
- > Van Cittert
 - > Better on Lunar / Planetary
- > Filters:Expert Filters:Deconvolution

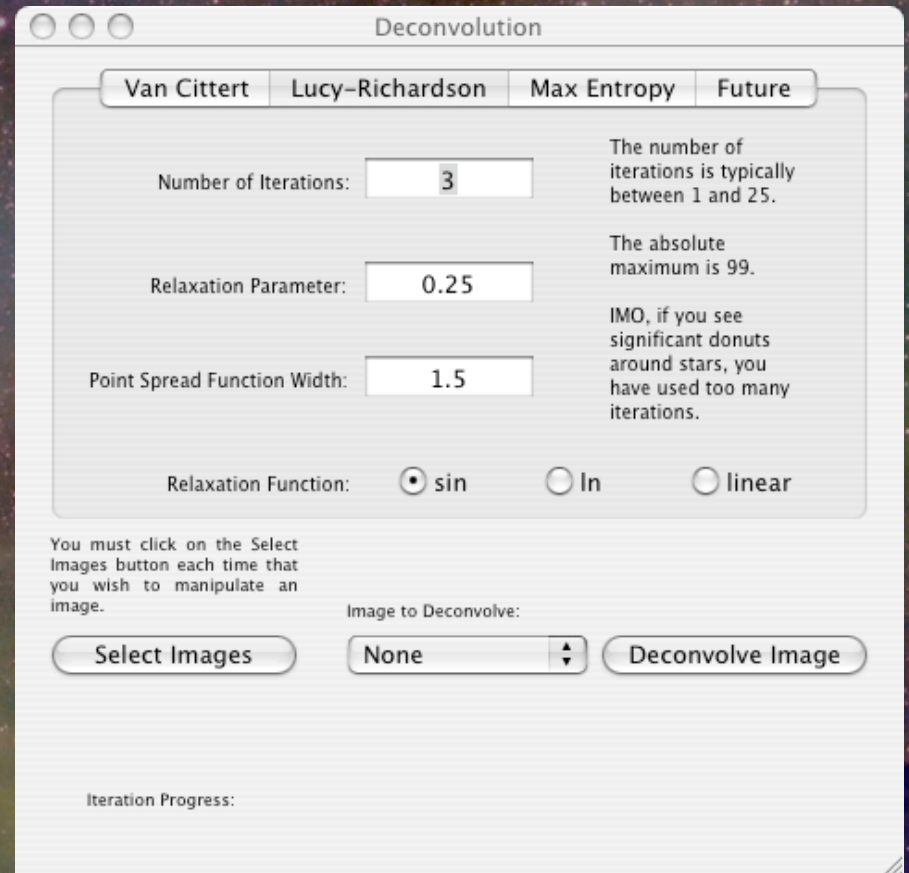
Deconvolution

- > Number Of Iterations
- > Relaxation Parameter
 - > Controls How Fast Dim Regions Converge
- > PSF Width
 - > Width of Perfect System
- > Relaxation Function
 - > Controls What Is A Dim Region



Deconvolution

- > Select Images Button Populates Images
- > Pick The Image
- > Deconvolve



Van Cittert



> Lunar

Van Cittert



> Lunar

Van Cittert



> Lunar

Lucy - Richardson



> Dust Lanes Sharper, Better Defined

Lucy - Richardson



> Dust Lanes Sharper, Better Defined

Lucy - Richardson



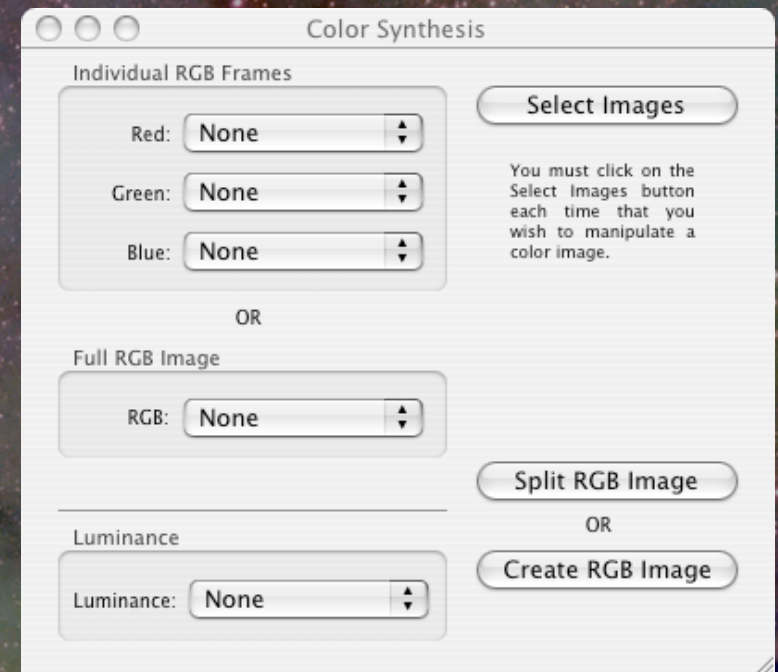
➤ Dust Lanes Sharper, Better Defined

Tri - Color Imaging

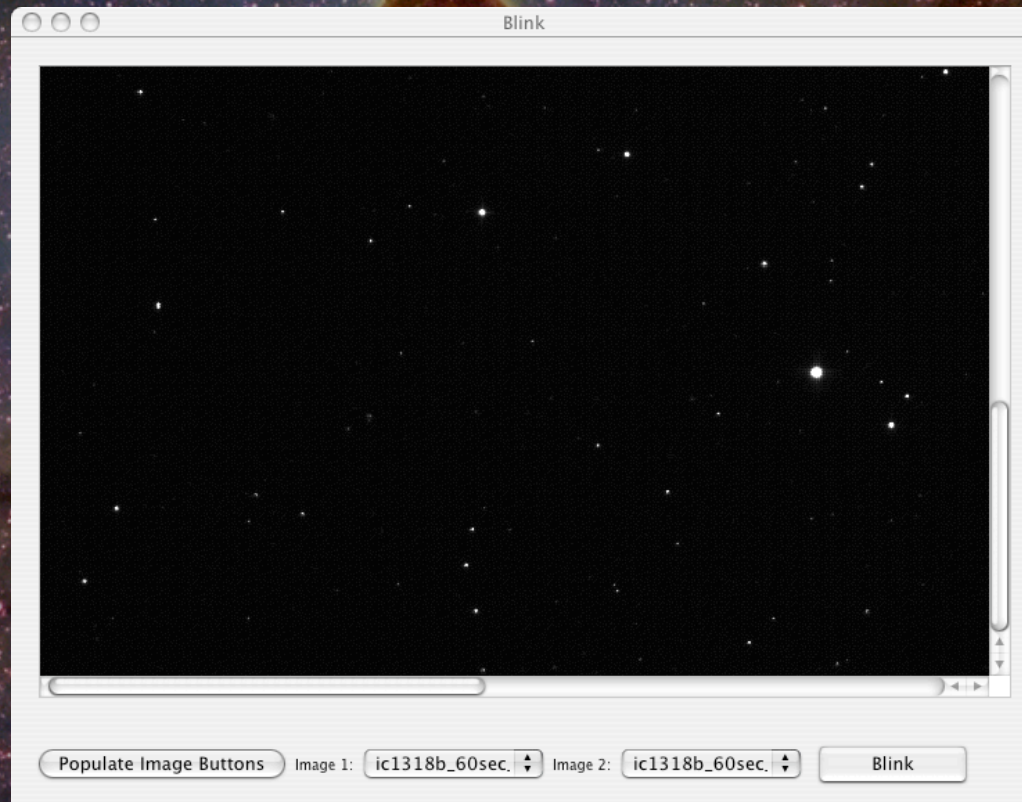
- > Combine L, R, G, B Frames
- > Split RGB Image To L, R, G, and B Frames
- > Create Synthetic Luminance Frame
- > Filters:Color Synthesis:LRGB Operations

Tri - Color Imaging

- > Select Images Button Populates The Frames
- > Select RGB/L Frames or RGB Frame
- > Create or Split Images
- > To Create A Synthetic Luminance From RGB Frames
- > Create an RGB Then Split



Blink



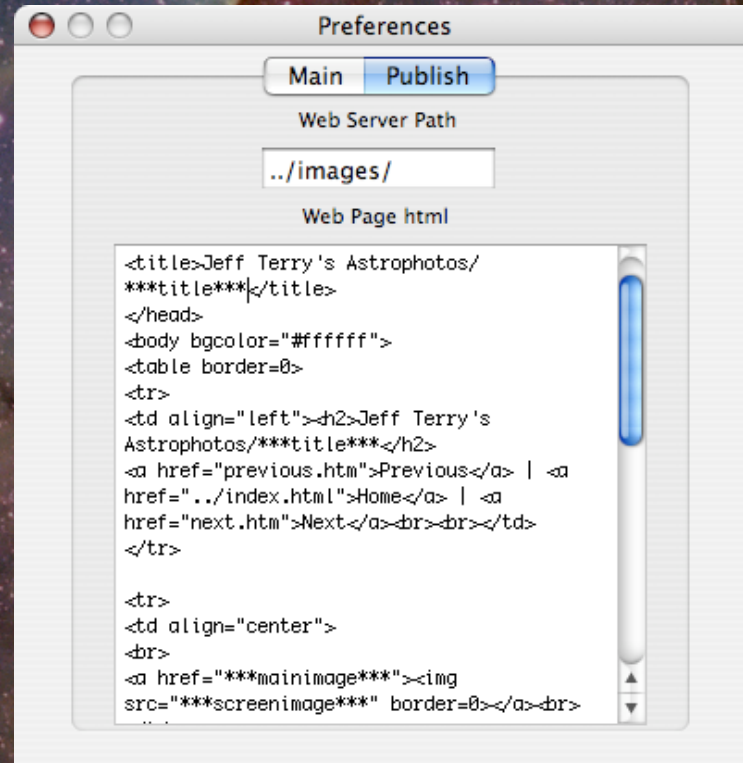
- > The Blink Routine Helps Supernova and Asteroid Hunters
- > Change Images While Blinking

Blink



> Supernova 2005cs

Help



➤ Make the computer do the work

Still To Come

- Autoguiding
 - SX Guider
 - Fishcamp Engineering Guider
- Advanced Deconvolution Routines
- Improved Alignment Routines - Done
- Easy of Use Improvements

Summary

- > Simple
- > No Feature Bloat
- > Most Features Used On Every Image
- > Easy To Create Pretty Pictures
- > Mac - Only

Contact

- > <http://www.iccd.us>
- > <http://www.macaastroimager.com>
- > <http://www.macaastroimaging.com>
- > terryj@iit.edu

Remote Observing

GRAS Desktop File Edit Window Help

GRAS Desktop

Status AREO1-5 Weather AREO6 Weather AREO7 Weather AREO8 Weather AREO9Weather Information

Current Status

- ☒ AREO1: Available
- ☐ AREO2: In Use: ewiley.gras
- ☐ AREO3: In Use: jnoble
- ☐ AREO4: In Use: hccedu
- ☐ AREO5: In Use: allancook
- ☐ AREO6:
- ☐ AREO7: In Use: rosner
- ☐ AREO8: Closed Day Time
- ☐ AREO9: Closed Day Time

AREO1-5
AREO6
AREO7
AREO8
AREO9

AREO1-5
Monday, February 12, 2007
19:34:13

AREO6
Tuesday, February 13, 2007
12:34:13

AREO7
Tuesday, February 13, 2007
04:34:13

AREO8
Tuesday, February 13, 2007
13:34:17

AREO9
Tuesday, February 13, 2007
13:34:18

FTP Server Buy Points GRAS Website RASO Website RAS Website

General Support: Arnie Rosner
Phone (24x7)
+714-501-8247
1-714-656-2436

Skype: Arnie Rosner: AREO1-4
Stefano Padovan: AREO5
Eddie Trimarchi: AREO6
Ido Bareket: AREO7
Brad Moore: AREO8
Arnie Rosner: AREO9

> Global Rent A Scope

> http://www.macaastroimager.com/GRAS_Desktop.html

For Your Consideration

- > Evaluation
- > www.skyinsight.net/maic/eval.php
- > Magazine
- > www.astrophotoinsight.com



Thank you

- > Speakers
- > AI For All His Organizational Skills